

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

JT6M57-AS

JT6M57-AS CMOS SINGLE-CHIP LSI FOR LCD CALCULATOR

The JT6M57-AS is a single-chip microcomputer for 12-digit or 10-digit 2-memory calculator. JT6M57-AS can drive the liquid crystal display (LCD). Single power supply operation, wide operating voltage range and low-power consumption make it suitable for 1.5 V solar battery operated calculator. Besides JT6M57-AS can selectable with a pin-programmable to function of Power timer and Memory hold.

FEATURES

Operational Features

- 12 digits or 10 digits (selectable with a pin-programmable) of data, 2 digits of sign, error symbol, memory load symbol.
- Algebraic mode.
- Standard 4 functions (+, -, ×, ÷)
- Memory and grand total (GT) memory calculation.
- Accumulating GT memory register with count up (down) item counter.
- Automatic percentage operation with add-on, discount.
- Automatic delta percentage, mark-up and markdown operations.
- Square root.
- Constant calculation.
- Chain calculation.
- Change sign.
- Floating minus.
- Key roll over function (2 keys).
- Fixed point ("0", "1", "2", "3", "4" or "6" places) or floating point (selectable with a switch).
- Adding point mode (selectable with a switch).

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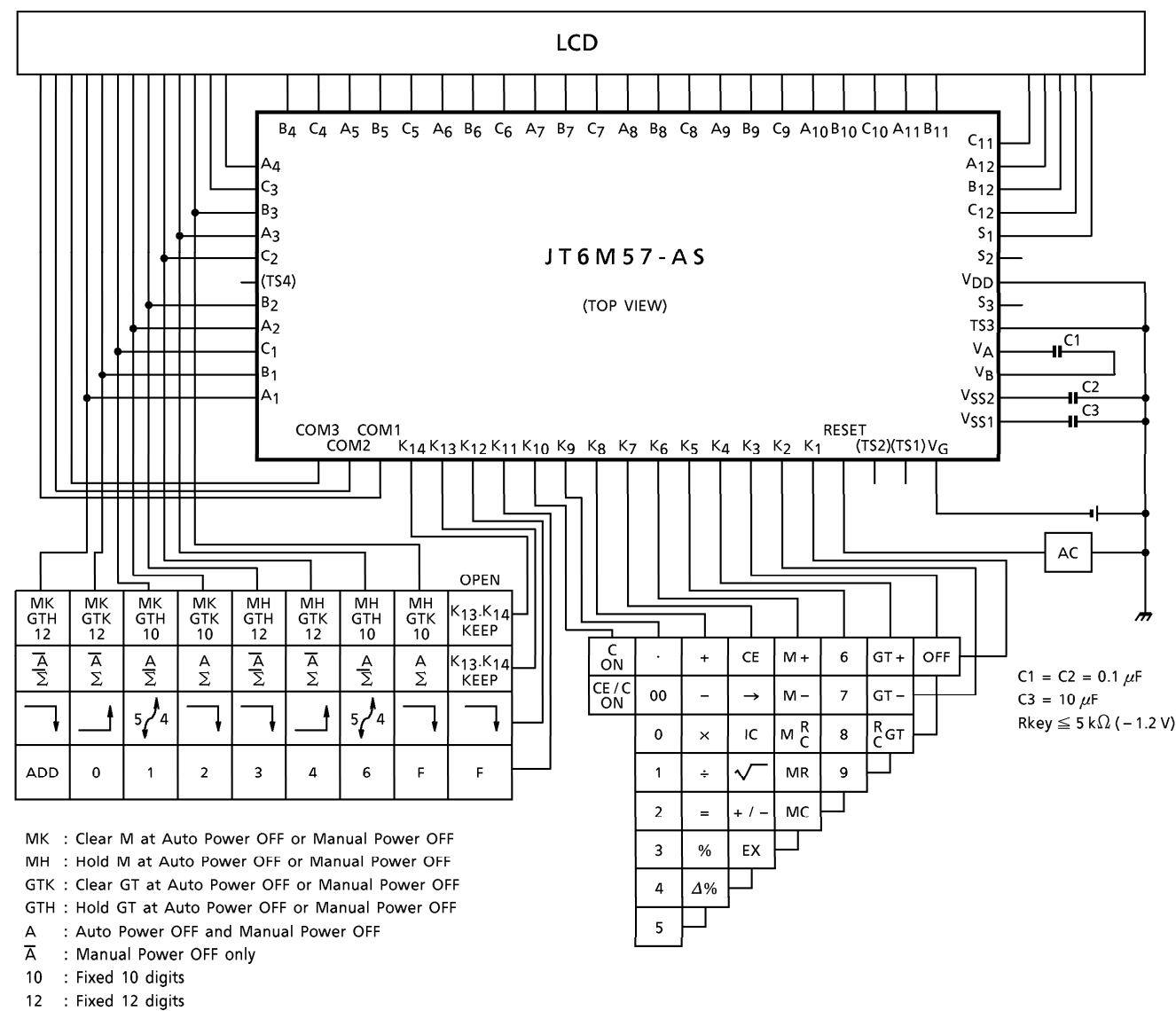
- Rounding switches (rounding up, down and off).
- Leading zero suppression.
- Trailing zero suppression.
- Punctuation on display, commas for thousands.
- Memory and GT memory contents indicator, turned on with non-zero in the memory and GT memory.
- Registration overflow, indicating that too many digits are entered (the most significant digit are protected).
- Result overflow, indicating during calculation (most function key are locked as it happened).
- Memory overflow indicating to flashing of memory load mark.

Electrical Features

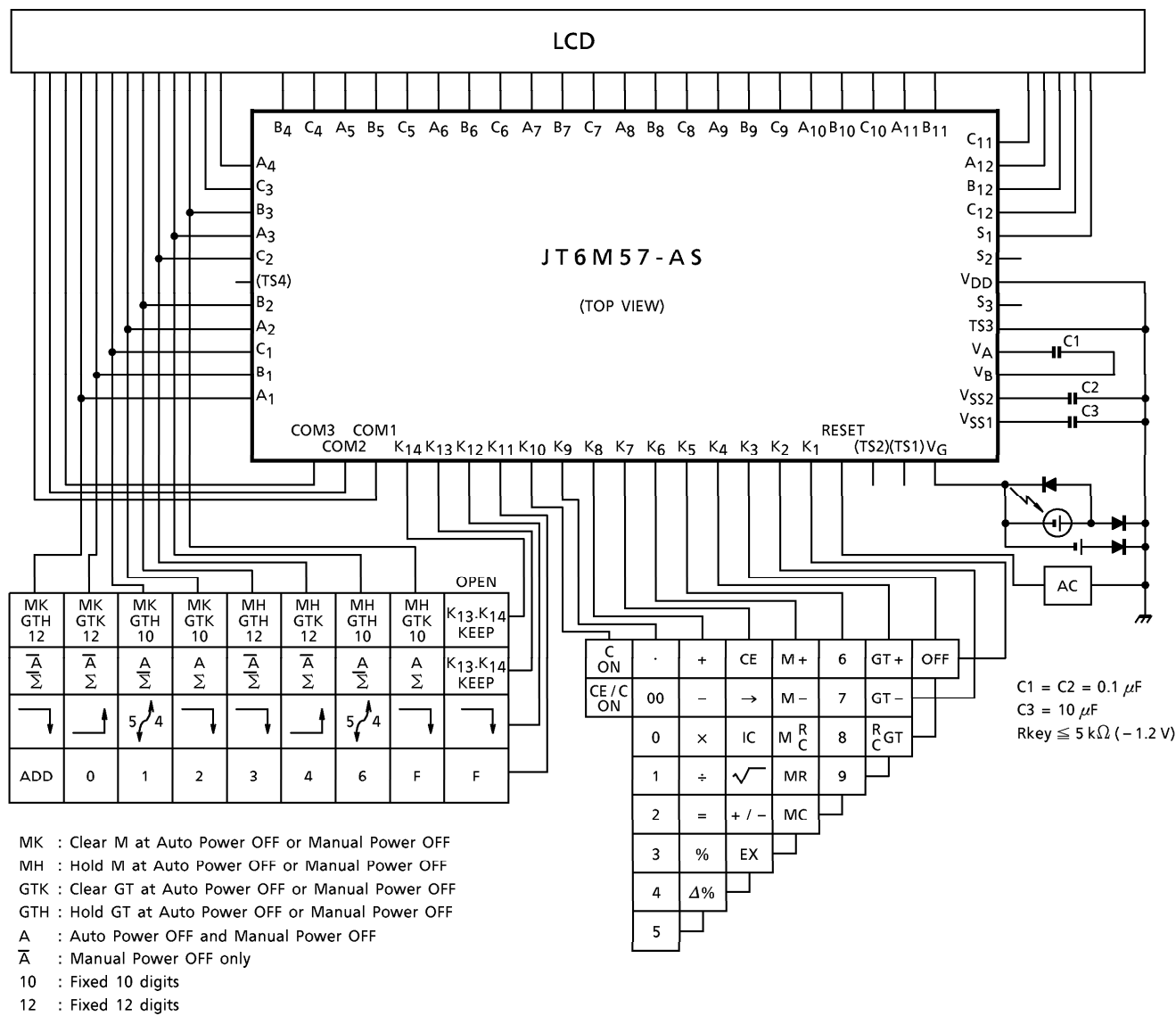
- Complementary output buffer for direct driving of liquid crystal display (F.E.M LCD).
- Oscillator/clock generator internal to chip.
- Keyboard encoding internal to chip.
- Keyboard denouncing internal to chip.
- Automatic power on clear.
- Wide supply voltage range (– 1.2 ~ – 2.0 V).
- Very low power consumption (3.3 μ W typ.).

SYSTEM BLOCK DIAGRAM

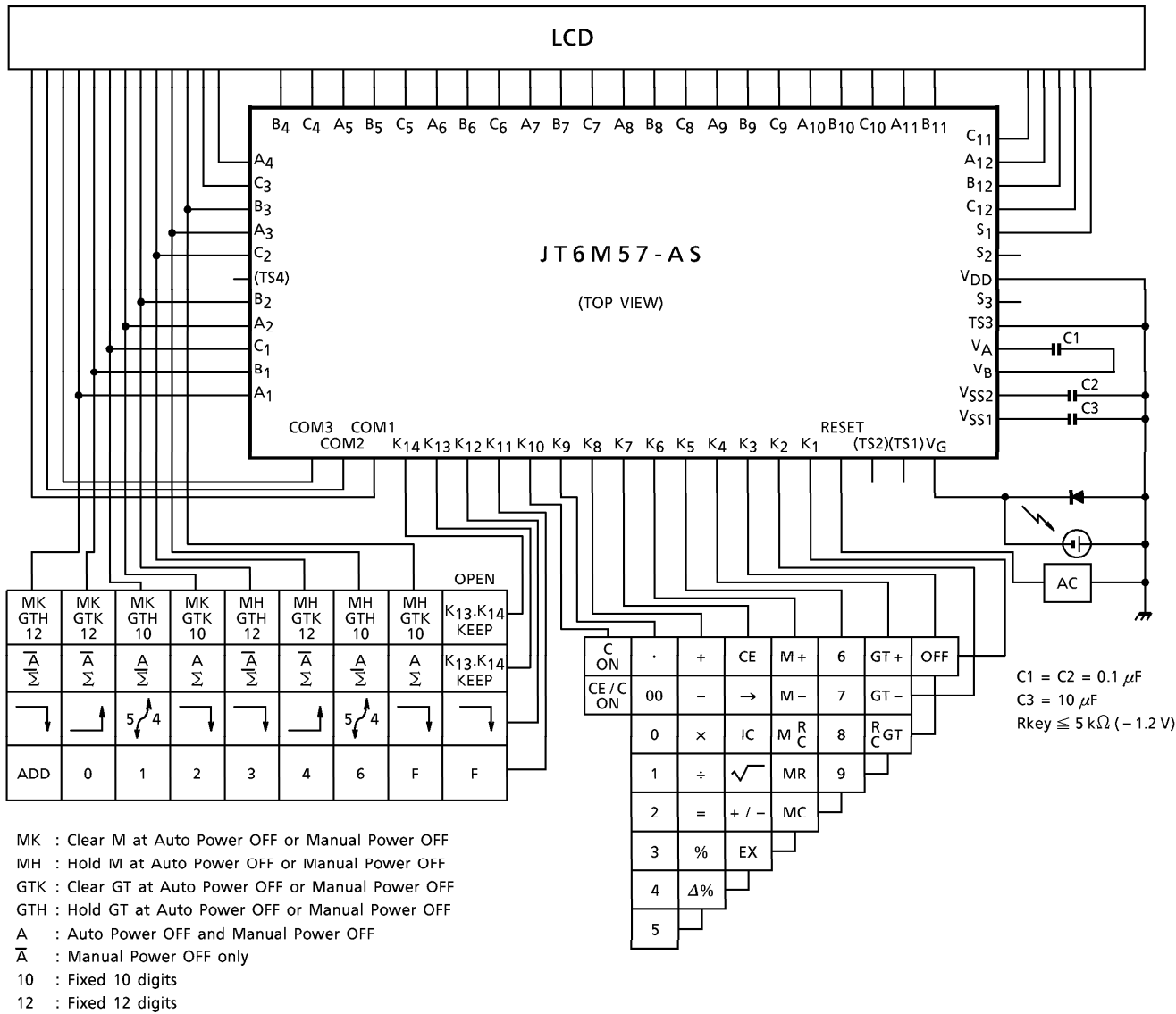
Battery Type



Dual Type



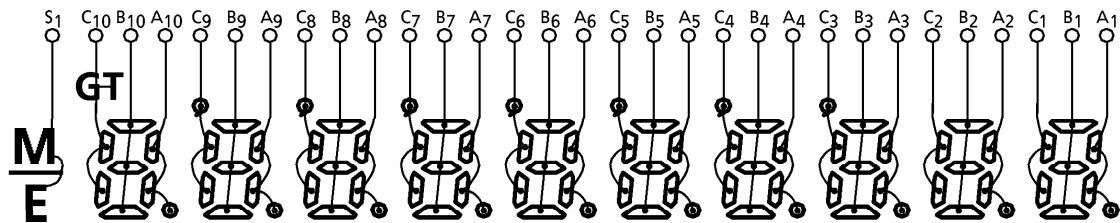
Solar Type



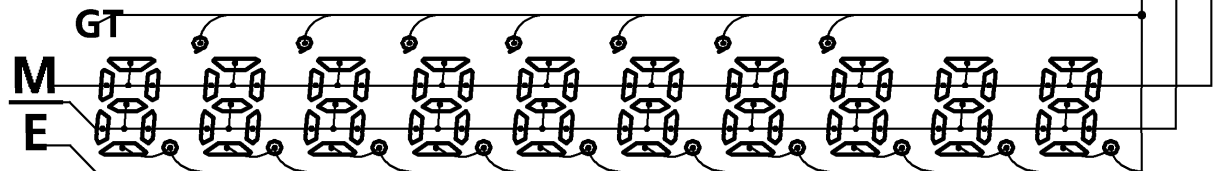
CONNECTION OF LCD

Select of 10 digits

SEGMENT

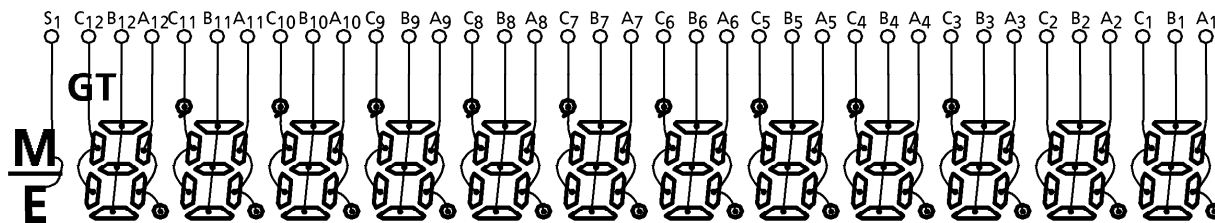


COMMON

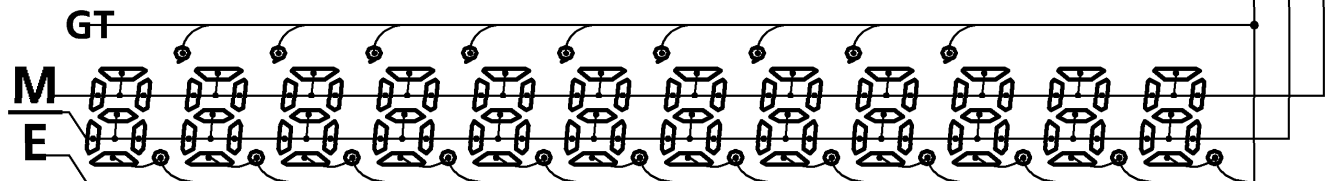


Select of 12 digits

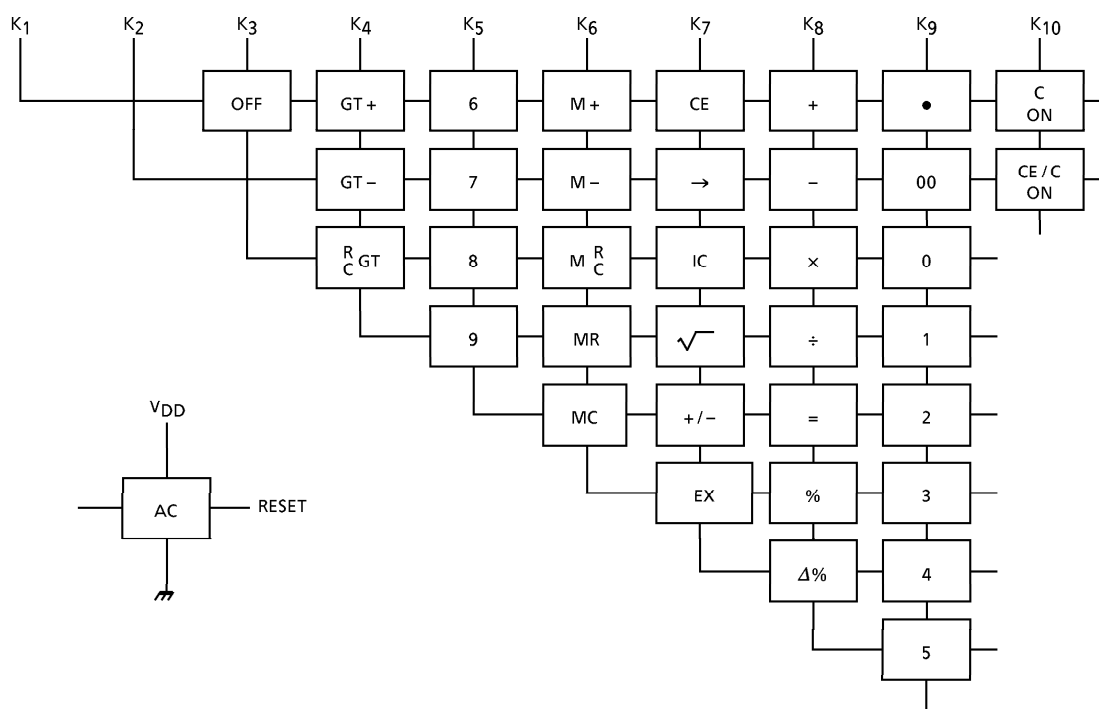
SEGMENT



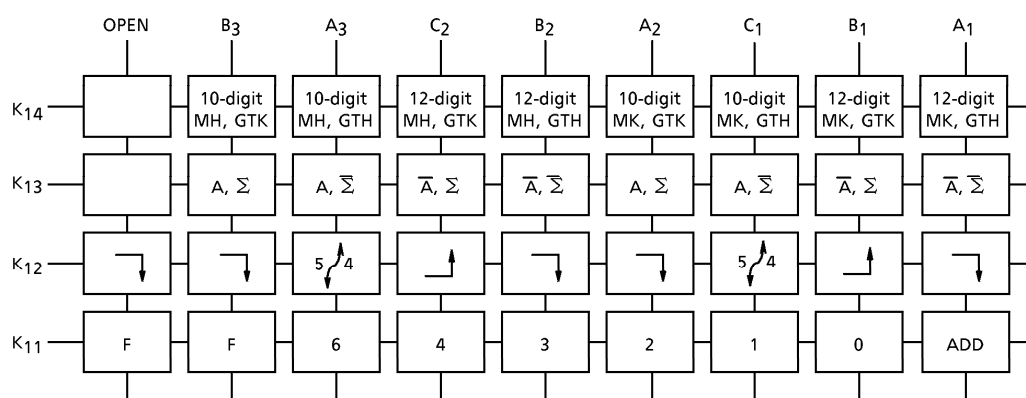
COMMON



KEY CONNECTION



Touch Key



Lock Key

- K14 Selectable with Calculated Digits and Memory Hold Status.
MH (Memory Hold), MK (Memory Kill), GTH (GT memory Hold) and GTK (GT memory Kill) at Auto Power OFF or Off Key.
- K13 Selectable with Auto Power OFF mode and Total switch.
- K12 Rounding switches.
- K11 Selectable with Fixed point or Floating mode.

SPECIFICATION OF CALCULATOR

Speed of caluculation (standard oscillating frequency f_{ϕ} = 48 kHz)

Numeral	11.8~17.7 ms
Function	$\left\{ \begin{array}{l} 1 \text{ [+]} \dots\dots\dots 25.6 \text{ ms} \\ 1 \text{ [+] } 2 \text{ [+]} \dots\dots\dots 95.2 \text{ ms} \end{array} \right.$	
Addition and Subtract	$\left\{ \begin{array}{l} 1 \text{ } 2 \text{ } 3 \text{ [+] } 1 \text{ [=]} \dots\dots\dots 89.1 \text{ ms} \\ 9999999999 \text{ [-] } 0.000000001 \text{ [=]} \dots\dots 111.8 \text{ ms} \end{array} \right.$	
Multiply	$\left\{ \begin{array}{l} 1 \text{ } 2 \text{ } 3 \text{ [x] } 2 \text{ [=]} \dots\dots\dots 109.6 \text{ ms} \\ 1 \text{ [x] } 9999999999 \text{ [=]} \dots\dots\dots 207.7 \text{ ms} \end{array} \right.$	
Devide	$\left\{ \begin{array}{l} 1 \text{ } 2 \text{ } 3 \text{ [\div] } 3 \text{ [=]} \dots\dots\dots 147.9 \text{ ms} \\ 9999999999 \text{ [\div] } 1 \text{ [=]} \dots\dots\dots 249.0 \text{ ms} \end{array} \right.$	
Memory calculation	$\left\{ \begin{array}{l} 2 \text{ [M+]} \dots\dots\dots 143.3 \text{ ms} \\ 9999999999 \text{ [\div] } 1 \text{ [M+]} \dots\dots\dots 296.2 \text{ ms} \end{array} \right.$	
Square root	$\left\{ \begin{array}{l} 9999999999 \text{ [\sqrt{}]} \dots\dots\dots 167.7 \text{ ms} \\ 2 \text{ [\sqrt{}]} \dots\dots\dots 125.0 \text{ ms} \end{array} \right.$	

Keys for calculator

$\boxed{0} \boxed{.}$, $\boxed{0} \sim \boxed{9}$: Number
$\boxed{\cdot}$	
$\boxed{+/-}$: Changer Sign
$\boxed{+}$ $\boxed{-}$ $\boxed{\times}$ $\boxed{\div}$: Function

=

$\sqrt{}$

%

$\Delta\%$

M +

M -

GT +

GT -

:

Memory

MC

MR

M^R_C

R^R_{GT}

EX

:

Exchange

\rightarrow

:

Shift

IC

:

Item Counter

CE

CE/C (ON)

$C_{(ON)}$

:

Clear

OFF

:

OFF

AC

:

SYSTEM RESET

Operation example

1. Fixed point calculation

① Key	Display	Fixed Point Place
C	0.	DP = 3 (5 / 4)
2	2.	
\div	2.	
3	3.	
=	0.667	
2	2.	
\cdot	2.	
3	2.3	
+	2.3	
4	4.	
M +	6.300	
1	1.	
\cdot	1.	
2	1.2	
M +	1.200	
RM	7.5	

② Key	Display	Fixed Point Place
C	0.	DP = 0 (\uparrow)
1	1.	
\cdot	1.	
2	1.2	
3	1.23	
+	1.23	
1	1.	
\cdot	1.	
1	1.1	
=	3.	
9	9.	
$\sqrt{}$	3.	
\times	3.	
1	1.	
\cdot	1.	
1	1.1	DP = F
=	3.3	

2. Adding point mode calculation

Key	Display	Key	Display	Key	Display
\boxed{C}	0.	$\boxed{M+}$	0.02M	$\boxed{=}$	33.27M –
1	1.	3	3.M	2	2.M
23	123.	.	3.M	$\boxed{+}$	0.02M
$\boxed{+}$	1.23	123	3.123M	9	9.M
3	3.	$\boxed{M+}$	3.12M	$\boxed{\cdot}$	9.M
$\boxed{=}$	1.26	\boxed{RM}	3.14M	$\boxed{\sqrt{}}$	3.M
3	3.	\boxed{C}	0.M	$\boxed{=}$	3.02M
2	32.	1	1.M		
$\boxed{\times}$	32.	23	123.M		
3	3.	$\boxed{-}$	1.23M		
$\boxed{\cdot}$	3.	3	3.M		
000	3.000	4	34.M		
$\boxed{=}$	96.00	$\boxed{\cdot}$	34.M		
2	2.	5	34.5M		

3. Constant calculation

① Multiplication			② Division		
Key	Display	Constant	Key	Display	Constant
k	k		a	a	
$\boxed{\times}$	k		$\boxed{\div}$	a	
a	a		k	k	
$\boxed{=}$	k·a	k ×	$\boxed{=}$	a / k	÷ k
b	b	k ×	b	b	÷ k
$\boxed{=}$	k·b	k ×	$\boxed{=}$	b / k	÷ k
③ Addition			④ Subtraction		
a	a		a	a	
$\boxed{+}$	a		$\boxed{-}$	a	
k	k		k	k	
$\boxed{=}$	a + k	+ k	$\boxed{=}$	a – k	– k
b	b	+ k	b	b	– k
$\boxed{=}$	b + k	+ k	$\boxed{=}$	b – k	– k

⑤ Percentage

k	k	
$\boxed{\times}$	k	
a	a	
$\boxed{\%}$	$k \cdot a / 100$	$k \times$
b	b	$k \times$
$\boxed{\%}$	$k \cdot b / 100$	$k \times$

⑦ Add-on

k	k	
$\boxed{+}$	k	
a	a	
$\boxed{\%}$	$k \cdot (1 + a / 100)$	$k +$
b	b	$k +$
$\boxed{\%}$	$k \cdot (1 + b / 100)$	$k +$

4. $\Delta\%$ Calculation

① Key Display

a	a
$\boxed{+}$	a
b	b
$\boxed{\Delta\%}$	$100 \cdot (a + b) / b$

5. Mark-up, mark-down calculation

① Mark-up

Key	Display
a	a
$\boxed{\div}$	a
b	b
$\boxed{\Delta\%}$	$a / (1 - b / 100)$
$\boxed{\Delta\%}$	$ a / (1 - b / 100) - a $

⑥ Percentage

a	a	
$\boxed{\div}$	a	
k	k	
$\boxed{\%}$	$100 \cdot a / k$	$+ k$
b	b	$\div k$
$\boxed{\%}$	$100 \cdot b / k$	$\div k$

⑧ Discount

k	k	
$\boxed{-}$	k	
a	a	
$\boxed{\%}$	$k \cdot (1 - a / 100)$	$k -$
b	b	$k -$
$\boxed{\%}$	$k \cdot (1 - b / 100)$	$k -$

② Key Display

a	a
$\boxed{-}$	a
b	b
$\boxed{\Delta\%}$	$100 \cdot (a - b) / b$

② Mark-down

Key	Display
a	a
$\boxed{\div}$	a
b	b
$\boxed{+/-}$	-b
$\boxed{\Delta\%}$	$a / (1 + b / 100)$
$\boxed{\Delta\%}$	$ a / (1 + b / 100) - a $

6. Add-on, discount calculation

Add-on

Key	Display
① a	a
$\boxed{\times}$	a
b	b
$\boxed{\%}$	$a \cdot b / 100$
$\boxed{+}$	$a \cdot b / 100$
$\boxed{=}$	$a (1 + b / 100)$
③ a	a
$\boxed{+}$	a
b	b
$\boxed{\%}$	$a (1 + b / 100)$
⑤ a	a
$\boxed{\times}$	a
b	b
$\boxed{\Delta\%}$	$a (1 + b / 100)$

Discount

Key	Display
② a	a
$\boxed{\times}$	a
b	b
$\boxed{\%}$	$a \cdot b / 100$
$\boxed{-}$	$a \cdot b / 100$
$\boxed{=}$	$a (1 - b / 100)$
④ a	a
$\boxed{-}$	a
b	b
$\boxed{\%}$	$a (1 - b / 100)$
⑥ a	a
$\boxed{\times}$	a
b	b
$\boxed{+/-}$	- b
$\boxed{\Delta\%}$	$a (1 - b / 100)$

7. Average operation use of the item counter

Key	Display	Item Counter
A	A	0
$\boxed{+}$	A	1
B	B	1
$\boxed{+}$	A + B	2
C	C	2
$\boxed{+}$	A + B + C	3
D	D	3
$\boxed{+}$	A + B + C + D	4

Key	Display	Item Counter
$\boxed{-}$	A + B + C + D	2
D	D	2
$\boxed{+}$	A + B + C	3
E	E	3
$\boxed{=}$	A + B + C + E	4
$\boxed{\div}$	A + B + C + E	4
\boxed{IC}	4	4
$\boxed{=}$	(A + B + C + E) / 4	5

MAXIMUM RATINGS

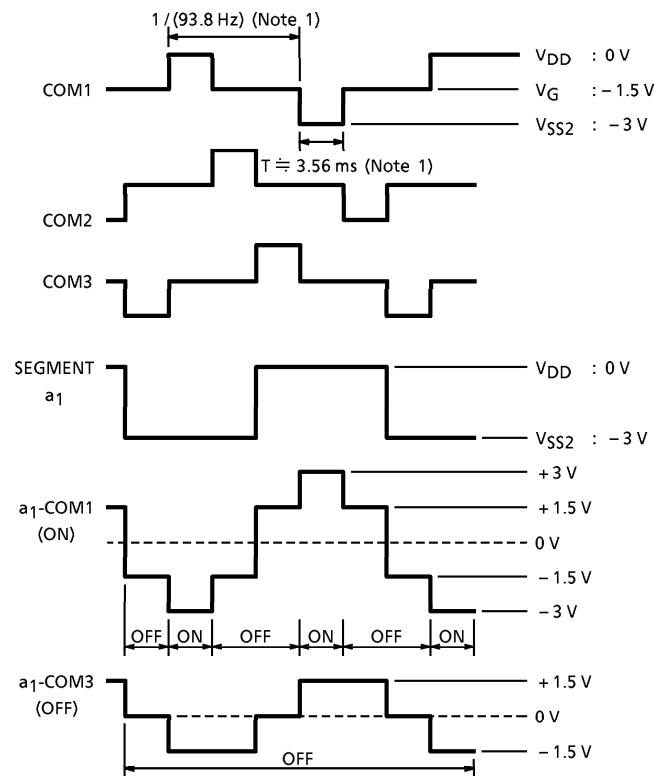
CHARACTERISTICS	SYMBOL	RATING	UNIT
Supply Voltage	V_G	+0.3 ~ -2.0	V
Input Voltage	V_{IN}	+0.3 ~ V_G - 0.3	V
Operating Temperature	T_{opr}	0 ~ 40	°C
Storage Temperature	T_{stg}	-55 ~ 125	°C

ELECTRICAL CHARACTERISTICS ($V_G = -1.5 \pm 0.2$ V, $V_{SS2} = -3.0 \pm 0.4$ V, $V_{DD} = 0$ V, $T_a = 25^\circ\text{C}$)

CHARACTERISTICS	SYMBOL	TEST CIRCUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
Operating Voltage	V_G	—	—	—	-1.2	-1.5	-2.0	V
"1" Input Voltage	$V_{IH}(1)$	—	K ₃ ~K ₁₀ RESET	—	$V_G + 0.4$	—	V_G	V
"1" Input Voltage	$V_{IH}(2)$	—	K ₁₁ ~K ₁₄	—	$V_{SS2} + 0.4$	—	V_{SS2}	V
"0" Input Voltage	V_{IL}	—	K ₃ ~K ₁₄ RESET	—	0	—	-0.4	V
"1" Output Voltage	$V_{OH}(1)$	—	SEGMENT COM1~3	—	$V_{SS2} + 0.2$	—	V_{SS2}	V
"0" Output Voltage	$V_{OL}(1)$	—	SEGMENT COM1~3	—	0	—	-0.2	V
"M" Output Voltage	V_{OM}	—	COM1~3	—	$V_G + 0.2$	—	$V_G - 0.2$	V
"1" Output Voltage	$V_{OH}(2)$	—	K ₁ ~K ₁₀	—	$V_G + 0.2$	—	V_G	V
"0" Output Voltage	$V_{OL}(2)$	—	K ₁ ~K ₁₄	—	0	—	-0.2	V
"1" Output Resistance	R_{OH}	—	SEGMENT COM1~3	$V_{OUT} = V_{SS2} + 0.5$ V	—	—	70	kΩ
"0" Output Resistance	R_{OL}	—	SEGMENT COM1~3	$V_{OUT} = -0.5$ V	—	—	70	kΩ
Key Pull Up Resistance	$R_{KEYH}(1)$	—	RESET	$V_{OUT} = 0$ V	156	—	364	kΩ
	$R_{KEYH}(2)$	—	K ₁ ~K ₁₀	$V_{OUT} = 0$ V	240	—	560	
Key Read Pull Up Resistance	$R_{KEYH}(3)$	—	K ₁ ~K ₁₀	$V_{OUT} = 0$ V	30	—	600	kΩ
Key Pull Down Resistance	$R_{KEYL}(1)$	—	RESET K ₁ ~K ₁₀	$V_{OUT} = -0.5$ V	—	—	10	kΩ
	$R_{KEYL}(2)$	—	K ₁₁ ~K ₁₄	$V_{OUT} = V_{SS2}$	120	—	800	
Oscillating Frequency	(WAIT)	$f_{\phi WAIT}$	—	$V_G = -1.5$ V	5.4	9.0	12.6	kHz
	(OPERATE)	$f_{\phi OP}$	—	$V_G = -1.5$ V	28.8	48	67.2	
Frame Frequency	f_F	—	SEGMENT COM1~3	$V_G = -1.5$ V	56.3	93.8	131	Hz

CHARACTERISTIC		SYMBOL	TEST CIR- CUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
Supply Current	1 (WAIT)	I _{DDWAIT}	—	—	V _G = -1.5 V	—	2.2	3.4	μA
	2 (OPERATE)	I _{DDOP}	—	—	V _G = -1.2 V	—	7.0	11.0	
	3 (OFF)	I _{DDOFF}	—	—	V _G = -1.5 V	—	—	2.0	
Power Off Timer Times		T	—	—	V _G = -1.5 V	429	600	1001	s

WAVEFORMS FOR DISPLAY



(Note 1) : at $f_{\phi} = 9 \text{ kHz}$

PAD LOCATION TABLE

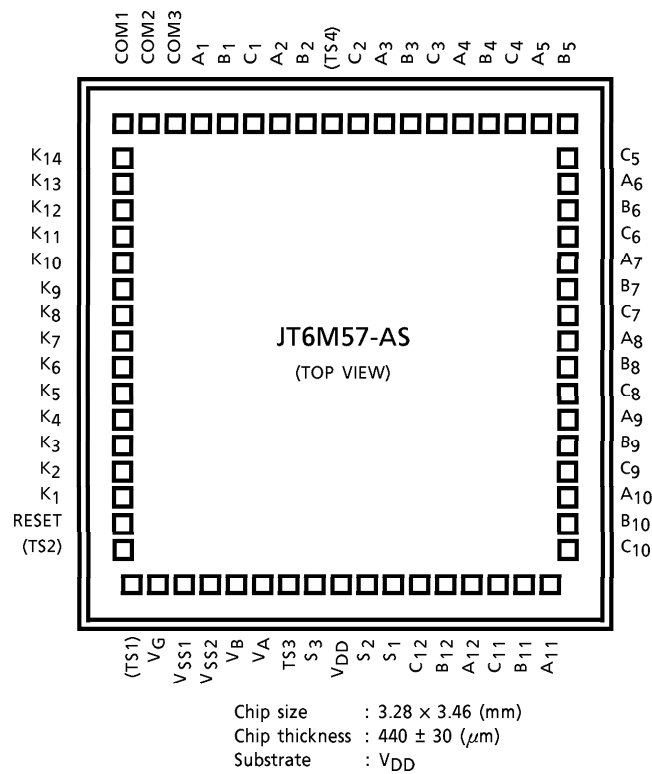
(μm)

NAME	X POINT	Y POINT
(TS1)	– 1367	– 1469
VG	– 1160	– 1469
VSS1	– 971	– 1469
VSS2	– 775	– 1469
VB	– 609	– 1469
VA	– 424	– 1469
TS3	– 252	– 1469
S3	– 100	– 1469
VDD	52	– 1469
S2	203	– 1469
S1	355	– 1469
C12	507	– 1469
B12	659	– 1469
A12	810	– 1469
C11	980	– 1469
B11	1162	– 1469
A11	1358	– 1469
C10	1408	– 1193
B10	1408	– 1042
A10	1408	– 890
C9	1408	– 738
B9	1408	– 586
A9	1408	– 435
C8	1408	– 283
B8	1408	– 131
A8	1408	20
C7	1408	172
B7	1408	324
A7	1408	475
C6	1408	627
B6	1408	779
A6	1408	936
C5	1408	1119
B5	1358	1469
A5	1169	1469
C4	999	1469
B4	847	1469
A4	696	1469

NAME	X POINT	Y POINT
C3	544	1469
B3	392	1469
A3	240	1469
C2	89	1469
(TS4)	– 89	1469
B2	– 240	1469
A2	– 392	1469
C1	– 544	1469
B1	– 696	1469
A1	– 847	1469
COM3	– 999	1469
COM2	– 1166	1469
COM1	– 1358	1469
K14	– 1408	1175
K13	– 1408	1023
K12	– 1408	871
K11	– 1408	720
K10	– 1408	503
K9	– 1408	352
K8	– 1408	200
K7	– 1408	48
K6	– 1408	– 104
K5	– 1408	– 255
K4	– 1408	– 407
K3	– 1408	– 559
K2	– 1408	– 710
K1	– 1408	– 862
RESET	– 1408	– 1023
(TS2)	– 1408	– 1175

(Note) : () Do not connect.

CHIP LAYOUT



PAD LAYOUT

